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Fourth Quarterly Progress Report

1 April through 30 June 1970

CONTINUED RESEARCH ON AIRCRAFT TIRE HYDROPLANING

NASA Contract NAS-1-9349

D. L. Project 3628/480

OBJECTIVE

To continue systematic experimental studies into the mechanics affecting aircraft tire hydroplaning.

CUMULATIVE PROGRESS

The rolling road table was modified in the area beneath the wheel to accept a water-cooled and lubricated bearing surface. This will allow testing at larger wheel loads without excessive heat generation, which was a problem in previous tests.

The smooth rubber drive drum, which itself tended to hydroplane at high belt speeds, was replaced by a chevion-treaded drum. The nylon belt which became unserviceable due to previous tests was replaced by a rubber belt.

The final report (R-1405) for the previous work has been printed and forwarded to NASA.

Previously-obtained data have been analyzed in detail utilizing the methods of statistical analysis. An empirical equation has been generated which relates the hydroplaning inception speed, water film thickness, and nominal tire contact patch bearing pressure.

PROGRESS DURING THIS REPORTING PERIOD

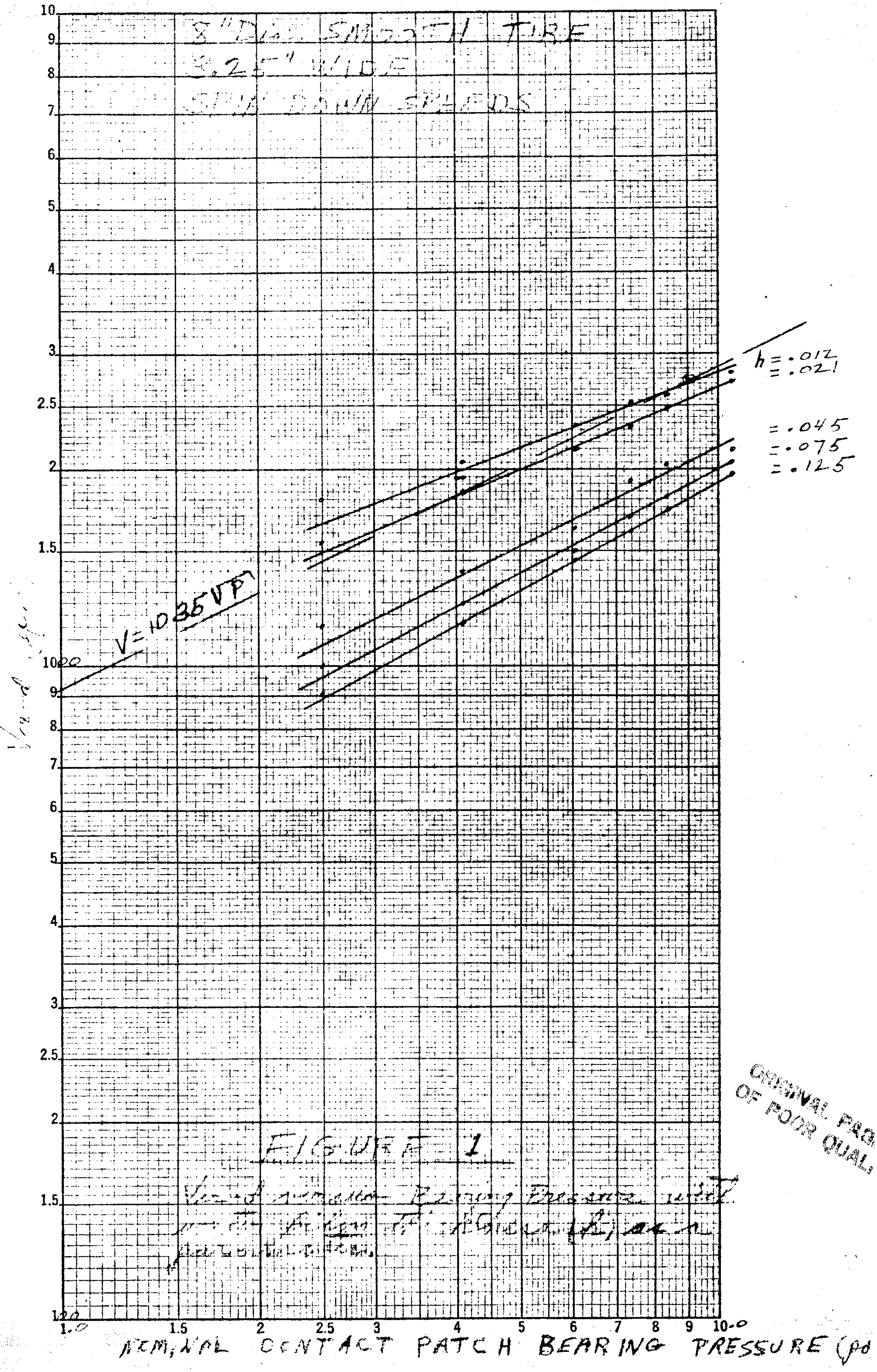
The results of an analysis of the previous data, utilizing the methods of statistical analysis, have been completed. An empirical equation was generated which relates the hydroplaning spin-down speed to contact patch bearing pressure and water film thickness. The results of this analysis are being presented in a separate letter report which is in the process of being printed.

Tests were performed on a smooth eight-inch diameter polyurethane model tire to generate a baseline for comparing future results and checking repeatability with previous tests. The hydroplaning spin-down and spin-up speeds were determined for loads varying from 5 pounds to 60 pounds, i.e., nominal contact patch bearing pressures of 2.5 to 11 psi, and water film thicknesses of 0.125, 0.075, 0.045, 0.021, and 0.012 inches. Figures 1 and 2 are a family of curves on log-log coordinates of spin-down and spin-up speeds versus nominal contact patch pressure with water film thickness as a parameter. In figure 1, a line corresponding to the equation, $V = 10.35\sqrt{p}$, proposed by NASA, has been included for comparison and reference. For our illustration, we let p equal nominal contact patch bearing pressure since our model tire does not have an inflation pressure as such.

The model tire was modified to have a tread pattern consisting of four ribs, 3/32 of an inch deep, equally spaced with a ratio of rib area to groove area of 1.0. Contact patch footprints as a function of load were determined and then the tire was tested under the same conditions as our baseline data. This process was repeated for rib depths of 3/32, 2/32, and 1/32 inch. Figure 3 shows a family of curves of hydroplaning spin-down speed versus load on log-log coordinates for a water film thickness of 0.021 inch with rib depth as a parameter. Similar curves have been generated for other water film thicknesses in order to determine the effect of tread depth on hydroplaning spin-down speed.

PLANS FOR THE QUARTER JULY TO SEPTEMBER 1970

Testing will continue on the 4-rib tire until the required data are obtained. The tire will then be modified to have eight ribs and the same ratio of rib area to groove area. This tire will be tested under the same conditions as the previous one to try and determine the effect of number of tread ribs on hydroplaning spin-down speed.



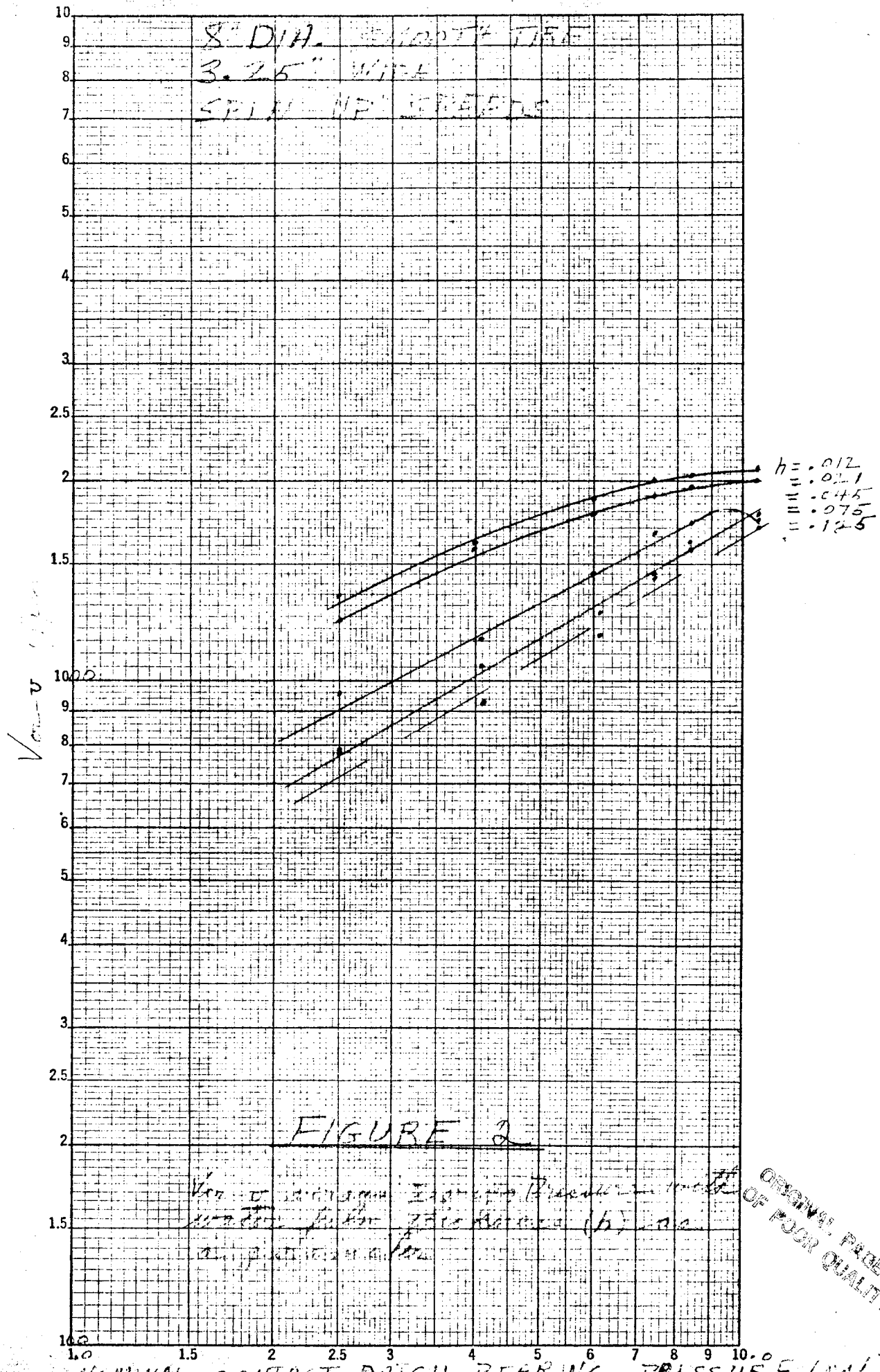


FIGURE 2

[illegible]

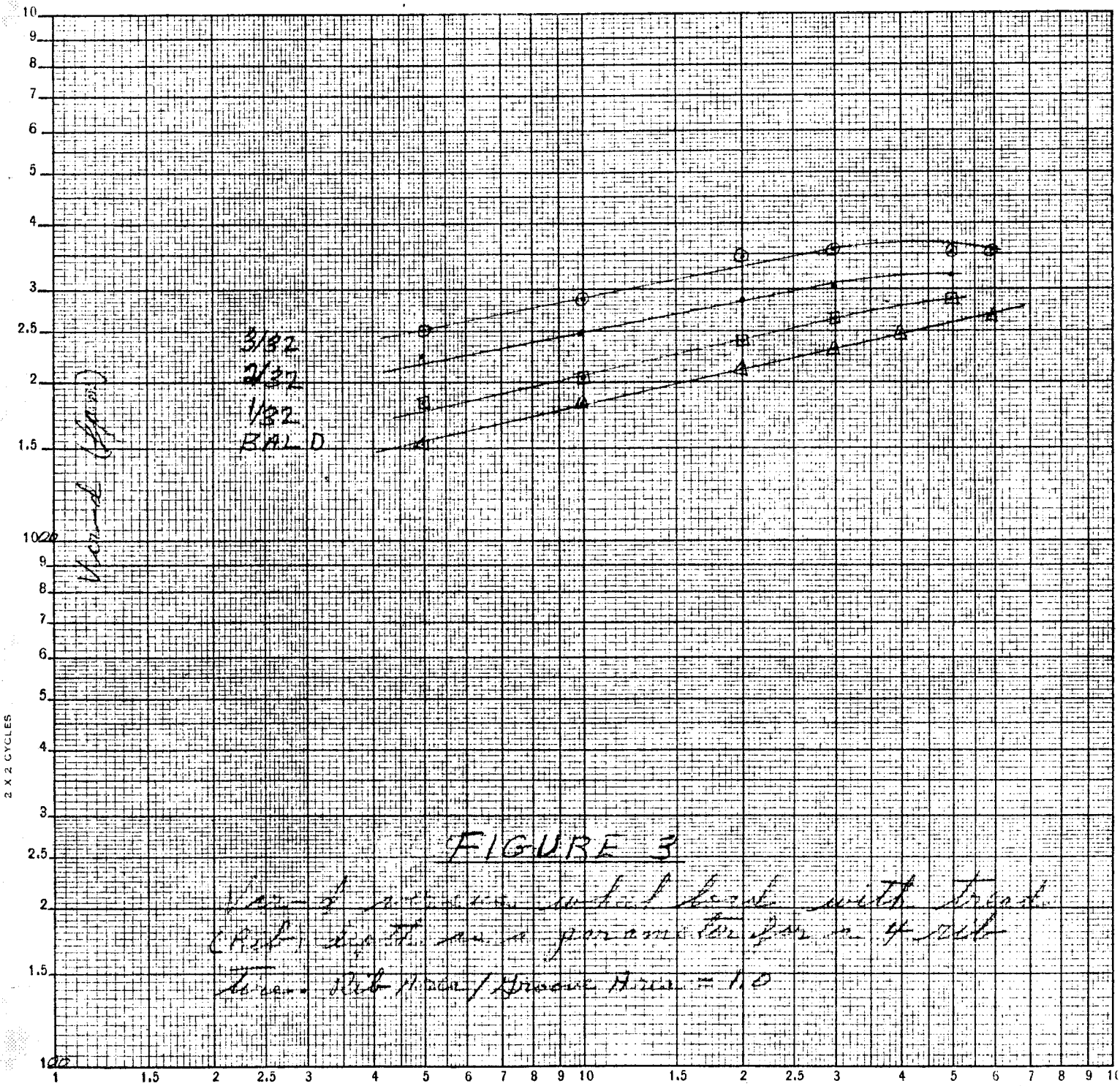


FIGURE 3